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Soviet Unconventional Fuels: Little Growth Ahead

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A Research Paper

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April 1985

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Soviet Unconventional Fuels: Little Growth Ahead [redacted] 25X1

A Research Paper

This paper was prepared by [redacted] Office of Global Issues. Comments and queries are welcome and may be directed to the Chief, Petroleum Resources Branch, OGI, [redacted] 25X1 25X1

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Soviet Unconventional Fuels: Little Growth Ahead 25X1

Overview

Information available as of 1 April 1985 was used in this report.

A detailed analysis of Soviet literature suggests that Soviet unconventional energy sources will not significantly increase Soviet energy output through the end of this century. Development costs for unconventional fuels are high, many of the processing technologies for large-scale production have yet to be fully developed, and the Soviets probably will need to direct a larger portion of their overall energy investment to prop up sagging sectors such as oil and coal. 25X1

Unconventional fuels such as oil shale, peat, and wood—which accounted for about 2 percent of Soviet fuel production in 1983—will continue to account for a slowly declining proportion of the national total. Oil shale is the only fuel source in this group with realistic possibilities of expanded production within the next 15 years. Despite official Soviet claims, we believe renewable energy sources such as solar, geothermal, tidal, and wind probably will remain primarily on the drawing boards and contribute little to Soviet energy needs. 25X1

Soviet plans specify that unconventional fuel production from renewable energy sources will increase by about 20-40 million metric tons of standard fuel equivalent annually from the 1983 levels—the energy equivalent of about 420,000 barrels of oil per day at the midpoint of the range—by the year 2000. Given the technical problems yet to be overcome and the comparatively low investment priority this sector will have, we believe the Soviets are unlikely to come close to meeting this goal. 25X1

Although unconventional fuels are of minor significance overall, the Soviets have made some important applications:

- Oil shale production—concentrated in Estonia and Leningrad Oblast—fuels local heat and power stations and is a source of lubricants.
- Peat fuel is used in some of the more heavily populated and economically developed parts of the Soviet Union, even if costlier than alternative fuels brought in from the outside.
- Firewood production—although slowly decreasing in recent years—remains a significant fuel for households and for many local industries close to lumbering areas. 25X1

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Scope Note

This research paper is part of a continuing CIA effort to examine in detail energy resources of the USSR. The unconventional fuels program is one of the few parts of the Soviet energy picture that has not been studied by CIA in any detail. This type of study improves our ability to estimate long-range Soviet energy potential. 25X1

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Soviet Unconventional Fuels: Little Growth Ahead

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Introduction

Oil shale, peat, and fuel wood together compose about 2 percent (in metric tons of standard fuel equivalent)[1] of the total primary energy production of the Soviet Union and about the same share of domestic energy use (see table 1). In 1983 peat and oil shale each accounted for less than 1 percent and fuel wood slightly more than 1 percent of total energy production (see table 2). 25X1

Although relatively insignificant on a national level, all three energy sources are economic for many localities where consumers are far from sources of cheaper energy. These three energy sources are used principally by households, thermal electric power stations, and local industries such as lumbering and construction. 25X1

According to Soviet press reports, the USSR has shown increased interest in the prospects for new renewable sources of energy such as solar, geothermal, wind, and tidal power. All of these sources together contribute only marginally to Soviet energy production totals. However, Soviet planners have indicated in their long-term energy program published in 1984 that they intend to construct the physical infrastructure and technical base for the widespread use of nontraditional energy sources. According to the planners, these renewable new energy sources are expected to contribute 20-40 million tons of standard fuel equivalent by the year 2000, the end of the planning period. 25X1

This paper assesses current production trends and prospects for Soviet unconventional fuels through 2000. An overall assessment of Soviet unconventional fuel sources is presented together with an evaluation of their contribution to and future impact on the entire Soviet energy program. 25X1

[1] According to Soviet definitions, a ton of standard fuel has the energy equivalent of 5.1 barrels of oil or 844 cubic meters of natural gas. 25X1

Table 1
Minor Fuels: Soviet Production, in Standard Fuel Equivalent
Million metric tons

	Shale	Peat	Wood	Total
1960	4.8	20.4	28.7	**53.9**
1965	7.4	17.0	33.5	**57.9**
1970	8.8	17.7	26.6	**53.1**
1975	10.8	18.5	25.4	**54.7**
1980	11.8	7.3	22.8	**41.9**
1981	11.7	12.6	22.9	**47.2**
1982	11.2	8.3	23.3	**42.8**
1983	10.5	8.6	23.1	**42.2**

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Table 2
Minor Fuels: Share of Total Soviet Fuel Production
Percent

	Shale	Peat	Wood	Total
1960	0.7	2.9	4.1	**7.7**
1965	0.8	1.7	3.5	**6.0**
1970	0.7	1.5	2.2	**4.4**
1975	0.7	1.2	1.6	**3.5**
1980	0.6	0.4	1.2	**2.2**
1981	0.6	0.6	1.2	**2.4**
1982	0.6	0.4	1.2	**2.2**
1983	0.5	0.4	1.1	**2.0**

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Administration of Soviet Unconventional Fuels

Responsibilities for the organization and management of Soviet unconventional fuels are divided among many governmental ministries and academic and planning bodies. These various organizations are responsible for the various stages of planning, developing, and implementing the energy-related project. As with the overall Soviet energy economy, there is no "energy czar" for the unconventional fuels sector.

Several of the main branch ministries responsible for important parts of overall energy policy are also directing much of the unconventional fuels program. The Ministry of Power and Electrification (Minenergo) oversees tidal power and, with the Ministry of the Gas Industry, geothermal power. The Ministry of Coal supervises the production of both peat and oil shale. The Ministry of Land Reclamation and Water Resources (Minvodkhoz) plans and develops wind energy projects. The Ministry of the Timber, Pulp and Paper, and Wood Processing Industry has nominal control over the diverse activities involving the cutting and delivery of firewood to industries and households. Finally, a host of organizations are involved in various aspects of solar energy research and development including Minenergo; the National Academy of Sciences; several research institutes under regional branches of the Academy of Sciences in Turkmenistan, Uzbekistan, Armenia, and the Ukraine; and the USSR State Committee for Science and Technology.

Most of the unconventional fuels programs are relatively limited and are scattered over a large number of small units and organizations. This is especially true for the renewable sources of energy. A good example is the allocation of operational responsibilities for geothermal energy projects. The National Academy of Sciences is responsible for basic geothermal research; while the Ministry of Gas is in charge of drilling geothermal wells and developing the energy resources. Major potential users of this resource promote geothermal development. These organizations include Minenergo (power generation), the Ministry of the Chemical Industry (extraction of chemicals from geothermal brines), and the Ministry of Agriculture (use of geothermal resources for heating greenhouses, fish farming, and other agricultural uses).

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This organizational complexity has, more often than not, resulted in programs being advanced only haltingly under various halfhearted leaderships with no serious interest or commitment to developing not only geothermal, but the entire spectrum of renewable resources.

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There are also substantial problems with the development of such nonrenewable energy sources as oil shale and peat, seemingly placed in a more efficient organizational setting under the Ministry of Coal. Both shale and peat development efforts suffer considerably because they are considered sidelines to the Coal Ministry's primary mission of producing coal. Almost without exception, coal development and extraction efforts have been assigned higher priorities for receiving allocations of investment resources, with shale and peat having to settle for leftovers.

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Nonrenewable Fuels

Shale

Soviet geologists have estimated oil shale[2] reserves in the USSR to range from 190 billion to 220 billion tons.[3] Soviet reserves of oil shale in the proved categories ($A + B + C_1$) are 6.6 billion tons with three-fourths concentrated in the Baltic shale basin, which extends from Estonia (3.9 billion tons) into adjacent Leningrad Oblast (1.1 billion tons).[4] The only other large proved shale reserves are in Kuybyshev Oblast on the Volga River (0.72 billion tons). The Soviet

[2] Oil shale is a layered sedimentary rock rich in an organic material known as kerogen. When heated to above 480°C, the kerogen in the rock decomposes, releasing a liquid oil product.

[3] Estimates of world and US oil shale reserves vary enormously. One UN report estimated potential world reserves at some 26 trillion tons with US reserves totaling 24 trillion tons.

[4] We define "A" category reserves as roughly equatable to the Western category "proved." "B" category reserves equate to "proved on hold or in reserve," while "C_1" category reserves equate to "probable" reserves by Western classification.

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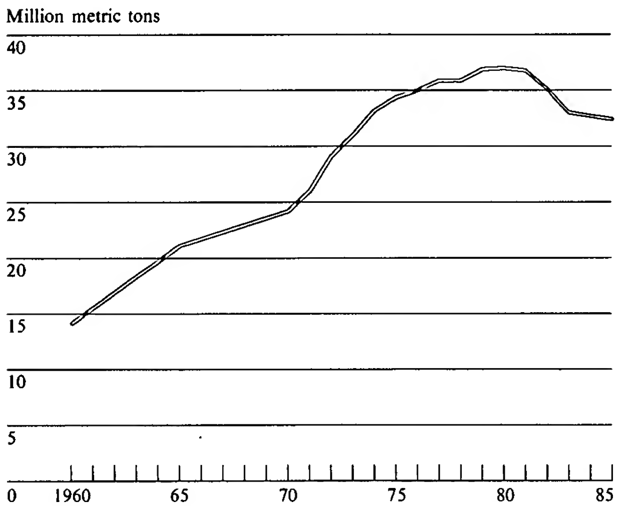
Figure 1
USSR: Oil Shale Production, 1960-85



Note: 1984-85 estimated.

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Union contains about 100 known shale fields, the majority concentrated primarily in the European USSR.

Soviet oil shale production, reflecting the distribution of reserves, is concentrated in Estonia and Leningrad Oblast, with the rest being mined in the Kashpirovka strip mine near Syzran' by the Volga River (see map following text, figure 7). In 1983, out of a total production of about 33 million tons, Estonia accounted for almost 28 million tons, Leningrad Oblast for more than 5 million tons and the Kashpirovka area for less than 1 million tons, (see figure 1).

Until almost 1960, Estonian shale was used as a solid fuel in small local heat and power stations and was processed at Kohtla-Jarve, the center of the mining district, to produce fuel oil, shale gas, gasoline, coke, and lubricants (see figure 2). This pattern changed sharply in the 1960s with the construction of two large shale-burning thermal power stations. The Baltic station opened west of Narva and reached its projected capacity of 1,600 megawatts (MW) in 1966. The Estonian central station, southwest of Narva, opened in 1969 and reached its designated capacity of 1,600 MW in 1972. The two stations, using almost 80 percent of expanding Baltic output, raised Estonia's electric power from 2 billion kilowatt-hours (kWh) in 1960 to 19 billion kWh in the late 1970s. They have provided an ample electricity supply for Estonia's own economy and leave a surplus of some 10-11 billion kWh for transmission to Leningrad Oblast and the Latvian SSR. The great need for a rapid shale mining expansion for power generation sparked the development of strip mines in Estonia after 1960. Four strip mines supplied more than half of Estonian production by the late 1970s. 25X1

The Soviets planned to increase oil shale production substantially in the Baltic region as part of the 1981-85 Five-Year Plan. By 1985 the Soviets had intended to increase production to as high as 68-70 million tons per year by expanding surface and underground mining. The task of increasing Baltic shale production by such a significant amount (approximately 30 million tons) relatively quickly now appears to have been totally unrealistic. 25X1

The Soviet press reported cutbacks in the generation of shale-fueled electric power and heavy accumulations of shale stockpiles, causing in turn a cutback in mine production. Stockpiles of 6-8 million tons were reported in 1983. The Soviets had also planned to build a 2,500-MW shale-fired power plant in Estonia. Construction of this plant, slated to be the world's largest shale-fueled station, was scheduled to begin sometime during the Eleventh Five-Year Plan (1981-85). However, the total lack of press reporting on this project in recent years indicates that the Soviets have apparently canceled or indefinitely postponed plans. Soviet expectations of a swelling Baltic regional demand for shale as an energy feedstock seemed to have soured because of a decline in demand by important industrial customers and changing patterns of energy use in the Baltic region.

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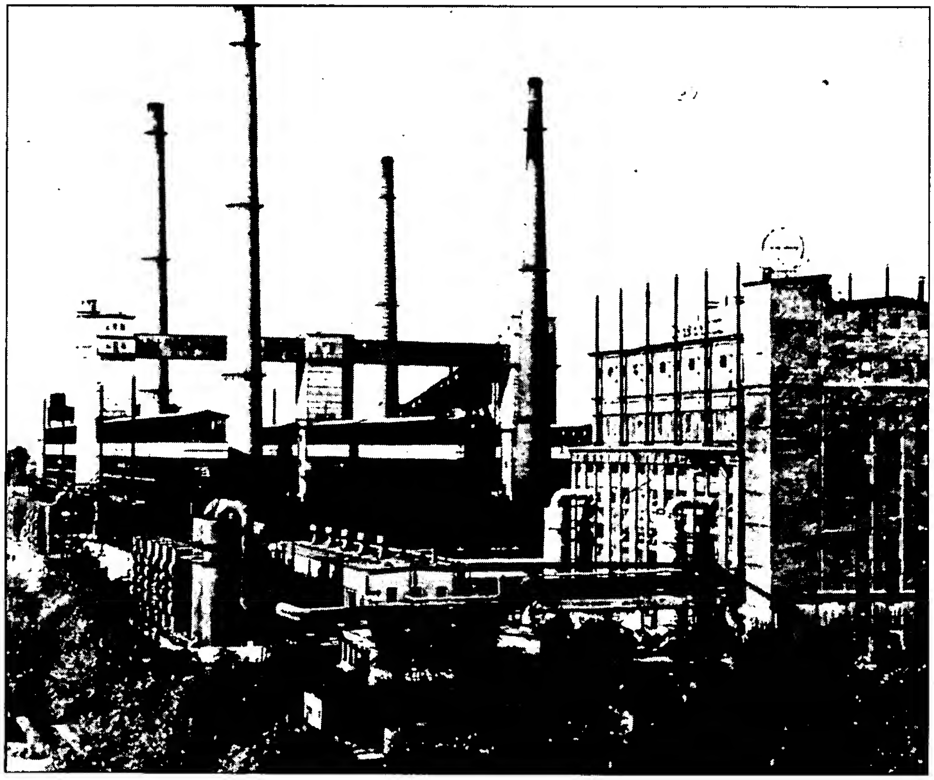
Difficulties were also caused by technical problems associated with a program to develop a new retorting [5] process that would yield both oil and gas. Soviet press articles indicate that the emphasis in the Estonian retorting pilot program has been on the UTT-3000 units, which are retorting units with a daily throughput capacity of 3,000 metric tons of shale. Two such retorting units, each with an annual capacity of close

[5] Retorting is the process by which a material, such as oil shale, is heated. 25X1

Figure 2. Oil shale processing plant at Kohtla-Jarve, Estonia. 25X1



to 1 million tons of oil shale, had been counted on to increase the efficiency of Estonia's two oil shale power stations, which now use shale in direct combustion with extensive emissions of ash and sulfur compounds and heavy residues of spent shale in boilers. Construction of the two UTT-3000 units began in 1976. The Soviet units were developed by ENIN, the Krzhizhanovskiy Power Research Institute. Tests began in 1980, proved unsatisfactory, and required the reconstruction of the two retorts, which were then retested in 1982. Aside from these technical difficulties, strong opposition to the retorting experiments were advanced by supporters of the direct combustion process.

There also appears to be a decline in demand by the Estonian shale industry's two most important customers—the two large Estonian shale-fired stations. The function of these stations appears to be changing since the installation of nuclear generating capacity at the Leningrad power station at Sosnovyy Bor. The availability of nuclear power, especially since the construction in 1980 and 1981 of additional capacity at the Leningrad station, has reduced the hours of use of the shale-generated stations, which are being used increasingly to cover daily peak loads. This general decline in use appears evident in the production trends of both oil shale and electric power in Estonia (see table 3). 25X1

In recent years the Soviets have mentioned plans for developing and expanding shale mining in several other parts of the USSR, including Belorussia, Orenburg, Komi ASSR, and Kuybyshev Oblast. Soviet sources claimed that the opening of two large open-pit mines in the Kuybyshev area alone would permit 25X1 recovery of about 100 million tons per year of oil shale. 25X1

Soviet engineers have claimed that approximately 20 million tons per year of shale oil could be retorted from raw oil shale in Kuybyshev Oblast and that most of this oil would be directly combusted in local

Table 3
Estonia: Production Trends in Oil Shale and Electric Power

	Oil Shale Production (*million metric tons*)	Power Generation (*billion kWh*)
1975	28.5	16.7
1976	29.0	18.6
1977	29.7	19.0
1978	30.4	19.1
1979	31.0	19.4
1980	31.3	18.9
1981	30.7	17.8
1982	29.3	18.5
1983	27.7	19.1
1984	27.4	18.3
1985 (Plan)	26.4	19.4

[redacted]

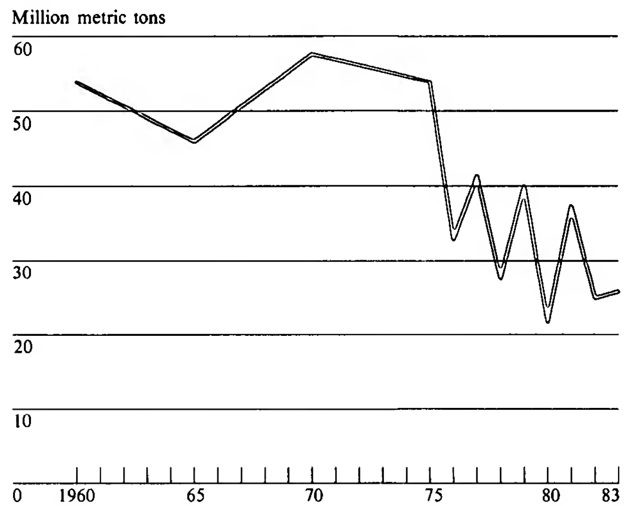
regional power plants. The conversion of these power plants from residual fuel oil to shale oil reportedly would save the Soviets about 92 million barrels of crude oil yearly. Soviet scientists have claimed that the processing of Estonian shales alone into shale oil would amount to some 750 million tons of syncrude. So far there have been no indications that this or any other shale expansion scheme has yet gotten off the ground. [redacted]

Peat

The USSR has over 60 percent of the world's peat resources with a total potential peat area estimated at 690,000 square kilometers, with proved and probable reserves of over 150 billion tons.[6] Some 25 billion tons of reserves in the A + B + C_1 categories have been identified, extending from Belorussia and the Baltic Republics in the west to Siberia and Kamchatka in the eastern USSR. Although the greatest reserves are situated in West Siberia (25 percent) and the Urals (35 percent), most production is concentrated in central Russia, which has only 8 percent of the reserves, and in Belorussia with but 1.5 percent of total national reserves. The USSR is by far the world's largest producer of peat, both for fuel (figure 3) and agriculture, accounting for over 95 percent of total world

[6] World peat resource estimates range from 230 billion to 250 billion tons. US resources are estimated to total almost 14 billion tons. [redacted]

Figure 3
USSR: Fuel Peat Production, 1960-83



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production.[7] Normally, annual production capacity is about 230 million tons. Over two-thirds of this total is used in agriculture. [redacted] 25X1

Soviet interest in the use of peat fuel is derived from the scarcity of fossil fuels in some of the more heavily populated and economically developed parts of the Soviet Union, notably central and northwestern USSR. The Soviets also use local resources, even if costlier than alternative fuels brought in from the outside. In terms of heat value, peat has an average calorific content of about 3,700 Btu's per pound. The poorest grade Soviet brown coal mined at the Moscow basin has a calorific value of 4,550 Btu's per pound. [redacted] 25X1

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Despite the apparent drawbacks of using low-calorific peat for power generation, further expansion of peat-fueled power stations was ordered in the late 1960s

[7] Agricultural uses of peat include organic fertilizers, cattle bedding, poultry litter, and insulation packing for fruits and vegetables. [redacted] 25X1

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and 1970s because of fuel shortages in central Russia. In recent years Soviet planners have felt increasingly that no more peat-fired power stations should be built, especially in light of the potential agricultural and chemical uses of peat. A section in the Soviet Long-Term Energy Program released in 1984 stated that the use of peat for fuel will be substantially reduced as early as the "next few years." Another 1984 Soviet report indicated that the processing of various chemical products from peat is 15 to 20 times more profitable than using peat as an energy source. A 1984 UN symposium report evaluating peat as an energy source concluded that no significant expansion in the use of peat in the power industry is expected and that the major use for peat in the future would be in agriculture.

Renewable Fuels

Wood

The USSR has one-fifth of the world's forests, stretching over 7.5 million square kilometers, or about a third of Soviet territory. Since 1965 the area of forest in the USSR has risen by almost 450,000 square kilometers and total timber reserves by about 4.5 billion cubic meters. During the 1980s, the lumbering industry has averaged a yearly total cut of over 350 million cubic meters of timber. Between 20 and 25 percent of this has been designated as firewood.

Firewood production has been slowly decreasing since 1965 but has remained a significant fuel for many small-scale local industries close to lumbering areas in the north and northwestern USSR and for households. Indeed, according to Soviet open sources, firewood accounts for about one-third of the fuel supply for Riga. Presumably, firewood accounts for a similar share of the fuel needs of other Baltic cities as well. Official national figures do not include wood burned by individuals, so total real consumption is actually much higher. Total private use may nearly equal the firewood cut by the lumbering industry. Overall, wood contributes 23 million tons of standard fuel equivalent, slightly more than 1 percent of the national energy total.

Geothermal

The USSR, along with several other countries, has been investigating geothermal energy as a renewable substitute for fossil fuels. According to the Soviet

Figure 4. Geothermal power station in Pauzhetka, Kamchatka. 25X1

literature, large areas of the Soviet Union containing substantial geothermal resources have already been surveyed. These regions include West Siberia 25X1 (Tobol'sk, Omsk), the Pavlodar and Karaganda regions of northern Kazakhstan, Central Asia, the Carpathian Mountains, Kamchatka, and the Kuril Islands (see map, figure 7). Because of generally high development costs, however, the Soviets apparently plan to exploit geothermal resources only in especially suitable locations that lack other energy sources. 25X1

The Kamchatka Peninsula has been the site of all Soviet efforts to use geothermal energy for electricity production. The first area to be developed for geothermal energy was at Pauzhetka, near the southern tip of the Kamchatka Peninsula. The Pauzhetka pilot plant, which operates on wet steam driving a turbine, went 25X1 into operation in 1967 with 5 MW of capacity (see figure 4). In 1981 the Soviets expanded the station, more than doubling its rated electrical capacity to 11 MW. Power from the plant is transmitted to a nearby fish cannery on the southwest coast of Kamchatka. Soviet figures released on Pauzhetka indicate that its investment cost was over 900 rubles per kW, eight to nine times more than the cost per kW usually indicated for thermal power stations. The Soviets claimed, however, that the operating cost per kWh at the Kamchatka site was three to five times less than that at diesel-powered stations elsewhere in Kamchatka.

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In another Kamchatka geothermal project, a pilot plant was constructed at Paratunka, a hot springs 25X1 area near Petropavlovsk. After starting up in 1967,

the plant—using a Freon-driven turbine system—operated for several years before being shut down because of operational difficulties. According to Soviet open press reports, however, hot water from the wells drilled at the site continue to be used to heat 60,000 square meters of greenhouses at the nearby Termal'nyy state farm. The Soviets planned to double this greenhouse area by the end of 1985. [redacted]

A more ambitious geothermal project proposed for the Kamchatka Peninsula is a 200-MW plant at the Mutnovskaya volcano some 80 kilometers south of Petropavlovsk. The first stage of this project, already under construction according to a 1985 report, is scheduled for completion sometime during the late 1980s and will give the station a capacity of about 50,000 kW. According to the Deputy Minister of Power and Electrification, "in the foreseeable future," the Soviets will be able to install geothermal power plants on Kamchatka with a total output capacity of up to 2,000 MW. [redacted]

Open-source reports indicate that the Soviets are also planning to construct power plants at three sites in the western part of the country—Dagestan, Stavropol' Kray, and the Carpathian Mountains. Construction has reportedly started on the Dagestan site at Tarumovka, north of Makhachkala. These pilot installations will use a closed-cycle underground circulatory system, which will eliminate environmental pollution—reportedly a problem at the Paratunka site. Soviet sources estimate that the potential reserves of such power in the USSR at depths down to 4,000 meters will make it possible to construct geothermal power stations with an aggregate capacity of 150,000 MW. About half of this capacity is in the European USSR—primarily in the Northern Caucasus, Armenia, the Crimea, and the Carpathian Mountains. The heat reserves in the Carpathians alone equal 5 billion tons of standard fuel equivalent, according to one Soviet report. [redacted]

The Soviets have asserted that the cost of using geothermal power in these areas would be substantially less than with coal or diesel-fired stations. Soviet open-source reports also maintain that, in the North Caucasus, 1 million calories (1 Gcal) of heat from geothermal sources is considerably less expensive than heat from thermal power resources. These reports also stated that, in certain areas of Kazakhstan, Central

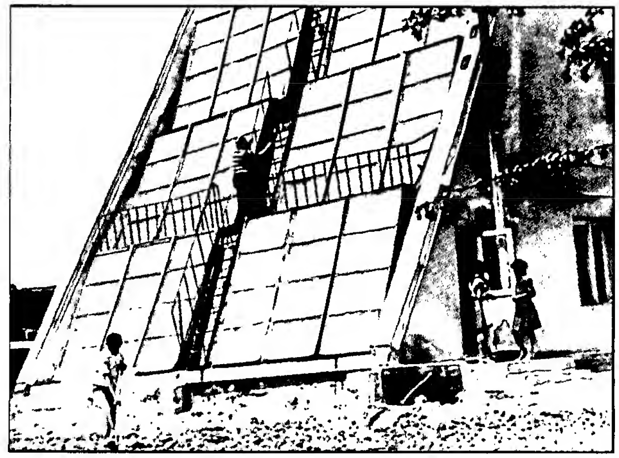

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Figure 5. Solar-heated collective farm building near Tashkent. [redacted] Sovphoto ©

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Asia, and West Siberia, costs for geothermal heat would be less than the rates for thermal heat. In recent years Soviet geothermal specialists have optimistically estimated that geothermal power stations could supply up to 5 percent of the USSR's electrical energy supplies by the year 2000. According to a USSR Academy of Sciences member, the expanded use of geothermal energy could save up to 140 million tons of standard fuel equivalent per year. [redacted]

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Solar

Solar research is coordinated by the USSR Academy of Sciences and the State Committee for Science and Technology. Research and testing are conducted mainly at institutes in regions of the Soviet Union, such as Uzbekistan or Turkmenistan, where this energy source is most likely to be used. In 1979 the Turkmen Academy of Sciences established the Scientific Research Institute also known as Solntse (sun). Solntse is developing solar energy equipment to meet small-scale energy needs in arid regions. [redacted] 25X1

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The Soviets believe that solar energy is not competitive with fossil fuels for any large-scale utilization. Soviet officials have indicated that they did not see solar energy as being of much importance except for water and space heating of individual houses in southern rural regions of the USSR (see figure 5).

Some Soviet energy researchers believe, however, that solar energy may be competitive with conventional sources in a few situations. These uses include small-scale solar power supplies in arid or remote regions for irrigating pastures and watering stock; pumping and desalinating water; supplying power for communications and cathodic protection of pipelines; and water heating, supplementary space heating, and air-conditioning for housing. According to a recent 1985 report, the USSR has over 90 installations using solar energy for heating.

Despite the fanfare devoted to planning solar energy applications, implementation has been halting. Although between 30 and 40 organizations participate in the solar energy applications program, there is still—according to critical Soviet press reports—no substantial serial production of equipment for solar installations, and no ministry has accepted responsibility for directing such production efforts. A small factory at Bukhara in Uzbekistan is the only known commercial producer of solar equipment, and it reportedly has been unable to meet its production goal for solar collectors. A 1985 open source indicated, however, that units under the USSR Ministry of the Construction Materials Industry have begun to produce solar-powered water heaters.

In the realm of large-scale production of solar electricity, the Soviets are still largely in the planning stage. Work commenced, however, in 1983 on the USSR's first solar power station in the Crimean village of Lenino by the Sea of Azov. Soviet press reports have stated that the station will have a capacity of 5,000 kW and will supply electricity to several nearby settlements. It will have 1,600 heliostats (movable mirrors), each with an area of 25 square meters, arranged in concentric circles around an 80-meter-high tower. The steam generators will be installed in the top of the tower. The total area of the field of mirrors is 40,000 square meters, ranking it as one of the world's largest solar installations. The site has over 230 sunny days a year. The plant will also contain a heat accumulator, which will store solar energy for use at night and during cloudy weather. The Soviets plan to extensively expand this initial site by constructing four more power units, each with a capacity of 50 MW.

The Soviets are also planning to construct another solar power station, tentatively sited at Talimardzhan in Uzbekistan, with a final capacity of 300 MW. Initially, the station, which will contain over 5,000 heliostats, will have a capacity of about 100 MW. A gas-burning standby unit will add another 200 MW to the station's capacity. The station could reportedly generate 2 billion kWh annually. A 1985 Soviet open-source report indicated that this project was still in the design stage. 25X1

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Tidal

The USSR is one of only three countries generating electricity from tidal currents. With French assistance, the Soviets constructed a small 400-kW experimental tidal power station in 1968 at Guba Kislaya near Murmansk on the Barents Sea (see figure 6). The station uses a very small, bulb-type, reversible generating pumping unit supplied by the French company that designed the much larger units used in the La Rance power station in Brittany, France. Although operational data and costs were not released, the Soviet chief engineer for the Guba Kislaya project said that it demonstrated the success of the concept and that the project's objectives were attained. 25X1

A number of potential sites for tidal projects have been surveyed throughout the USSR. The most favorable sites—those possessing the largest differences between high and low tide—occur along the northern coasts of the European USSR and around the Sea of Okhotsk in the Soviet Far East. The most recent project appears to be a larger experimental installation, with a generating capacity of 38,000 kW, planned for the Lumbovka area near the eastern end of the Kola Peninsula. This projected plant, scheduled for completion sometime in the late 1980s, would operate in tandem with a hydroelectric plant to be installed on the Iokanga River, just northwest of Lumbovka. 25X1

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Several other proposed installations are much larger, such as a 15,200-MW site on the Mezen' River that flows into the White Sea. The Soviets have estimated that a tidal station constructed at this location could

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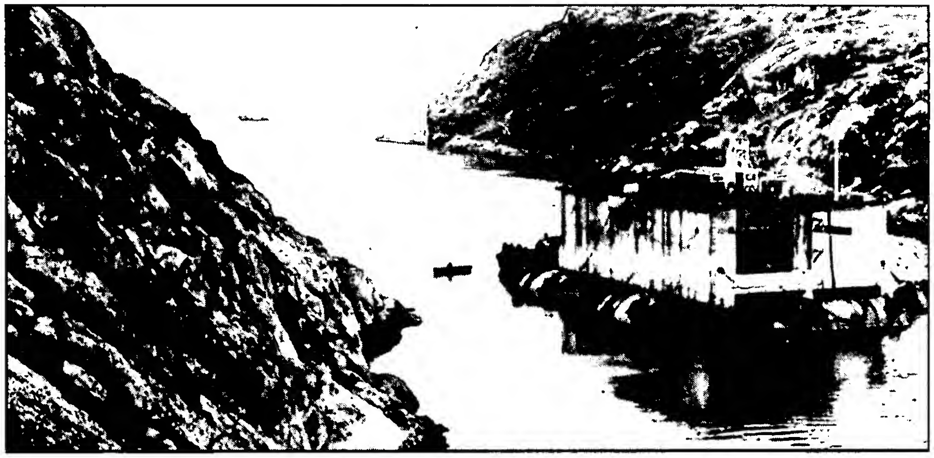
Figure 6. Guba Kislaya experimental tidal power plant near Murmansk on the Barents Sea.



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Sovphoto ©

generate an annual output of 50,000 million kWh. Feasibility studies have also been prepared on the construction of two large stations on the coast of the Sea of Okhotsk in the Soviet Far East. Soviet estimates of the capacity of one of these sites, Penzhinskaya Guba, run as high as 100,000 MW. A Soviet source stated that USSR tidal power could eventually produce 350 billion kWh a year. These projects, if carried out, however, would be the world's largest and most expensive hydropower installations.

The general absence of large energy consumers near most areas suitable for the construction of tidal power stations suggests that a substantial development of this energy source by the year 2000 is unlikely. At best we expect the construction of a few plants with a maximum capacity of a few megawatts by the turn of the century.

Wind

The USSR has extensive areas suitable for windpower sites. The Arctic coastlines, Ural Mountains, Baltic and Black Seas, and the steppes and mountainous regions of Kazakhstan and Central Asia are all regions with average wind velocities ranging from 18 to 25 kilometers per hour.

Windpower has been used for many years in agricultural and remote areas of the USSR. Over 10,000 small windmills are used in rural areas to pump water or to serve as auxiliary and sometimes autonomous sources of electric power. These Soviet-constructed wind generators have generally been small with power capacities ranging from 1 to 10 kW, although in 1931 the Russians constructed a 100-kW wind tower near Yalta on the Black Sea with an annual output of 280,000 kWh. During the 1930s, the Soviets considered building a much larger 5-MW system but never implemented the project. Since the 1950s, other units with up to 400 kW in power capacity have since been 25X1
installed at sites in Kazakhstan and the European Arctic. 25X1

In 1975 according to Soviet open source reports, a national company named Tsiklon (cyclone) was created under the Ministry of Land Reclamation and Water Resources, with the goal of developing and bringing windpower items into the Soviet economy. Tsiklon engineers reportedly have designed a series of windpowered electrical generators with capacities 25X1
ranging from 1 to 100 kW. In 1984, preparations were said to be under way for series manufacture of Tsiklon units combined with electric generators of some 2 to 8 kW of capacity. These devices were to be used for radio communications, automatic meteoro- 25X1
logical stations, signaling equipment, and cathodic anticorrosion protection of oil and gas pipelines.

A small plant in Astrakhan' reportedly has an annual 25X1
production capacity of 20,000 wind units. Soviet press articles stated, however, that the 1976-80 Plan called

for just 10,000 units to be produced and that only about 4,500 had been constructed by 1980. In the early 1980s, reports indicated that the plant was poorly equipped and that 80 percent of its capacity was engaged in producing items other than windpower devices. According to an open source, no more than 150 to 200 wind units were being produced yearly, and a 1984 report stated that this production volume had risen only slightly to about 250 units annually.

To solve the inherent drawback of fluctuating energy production associated with windpower, the Soviets are considering establishing combined wind- and solar-powered installations at sites near Lake Balkhash in southern Kazakhstan and Kara-Bogaz-Gol in western Turkmenistan. The Soviets also hope to construct much larger windpowered stations than the current Tsiklon series. Some of their engineers feel that generators with capacities of 2 to 4 MW and larger (up to 40 MW) are technically and economically feasible. The prevailing view of most Soviet energy planners, however, is that current prospects for windpower plants of this magnitude are highly uncertain.

Outlook

We believe that prospects are bleak for Soviet unconventional fuel sources providing any substantial production increments by the end of the 1990s. Many of the requisite processing technologies for large-scale production, especially for solar, geothermal, tidal, and wind, are likely to remain on the drawing boards for the near future. Although the processing technologies for oil, shale, and peat are better understood, in our view, developing these fuel sources would be costly and would add further problems to Soviet planners already faced with sharply rising costs for oil and coal. Finally, the Soviets probably will need to direct an even larger share of investment resources to prop up sagging oil and coal production, leaving comparatively minor amounts available for unconventional fuel development. Oil shale appears to be the only unconventional energy source likely to achieve any meaningful long-term production increase. In the short term, it is doubtful that oil shale will show any increase in output, given the operational difficulties and slackness in demand for Estonian shale production and the slowness in opening up Volga shale resources because of technical shortcomings and bureaucratic inertia. 25X1

In our view, chances are slight that peat will register any production upswing for energy purposes; Soviet planners are increasingly devoting their complete attention to expanding the use of peat for agricultural activities. The use of wood for fuel will continue to slowly, but steadily, decline by the end of the century. The growing use of bottled natural gas in rural and remote areas should hasten this trend. 25X1

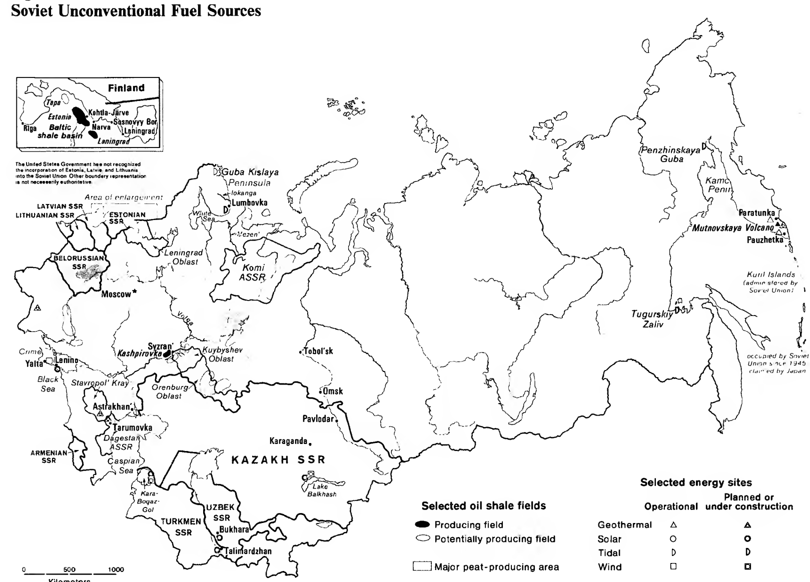
25X1

The Soviets have stated in their long-term energy program published in 1984 that nontraditional energy sources will substantially increase their production of energy resources by the year 2000. They expect the bulk of this production to come from the solar and geothermal sectors. Both these sectors have suffered in recent years from poor coordination in planning among the government agencies and research institutes responsible for planning, designing, and implementing scheduled projects. Indeed, organizational inefficiencies and technical shortcomings have plagued efforts to develop the entire spectrum of unconventional fuels. Many Soviet energy experts have expressed doubt in Soviet publications that any of the renewable technologies will make a lasting impact on the Soviet energy scene. At the same time, the Soviet energy bureaucracy has consistently been reluctant to risk any significant amount of investment resources on the relatively expensive, technologically risky long-term energy projects that need to be pursued before these new energy sources can be placed on a sound technological and operational base. These serious organizational and technical drawbacks associated with the entire field of unconventional Soviet fuels make it highly unlikely that (1) renewable energy sources will supply the planned annual production totals of 20-40 million tons of standard fuel equivalent expected by the 1990s, or that (2) unconventional fuels will supply more than the current 2-percent share of Soviet fuel production. 25X1

25X1

25X1

Figure 7
Soviet Unconventional Fuel Sources



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25X1